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प्रत्यक्ष अपचयन प्रक्रियाओं हेतु लौह आक्साइड भरण सामग्री के गुच्छन के निर्धारण की प्रणाली

Indian Standard

METHOD FOR DETERMINATION OF CLUSTERING OF IRON OXIDE FEEDSTOCK FOR DIRECT REDUCTION PROCESSES

ICS 77.080.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 2000

Price Group 1

Sponge Iron and Smelting Reduction Sectional Committee, MTD 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Sponge Iron and Smelting Reduction Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This Indian Standard has been prepared for measuring clustering tendency of iron ores lumps and pellets used as feedstock to direct reduction processes.

This will help in evaluation of the performance of iron ores considered suitable to direct reduction process applications, particularlv with reference to production of sponge iron through gas based direct reduction processes.

In the preparation of this standard, assistance has been obtained from ISO/TC 102/SC 5/N85E — Iron Ores — Determination of clustering of feedstock for direct reduction processes.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 JULY 2010
TO
IS 14795 : 2000 METHOD FOR DETERMINATION OF CLUSTERING OF IRON OXIDE FEEDSTOCK FOR DIRECT REDUCTION PROCESSES

(*Second Cover, Foreword, para* 5, *line* 2) — Substitute ‘calculated’ *for* ‘c alculated’.

(*Page* 2, *clause* **7**) — Substitute the following for the existing:

$$\text{Sticking Index} = \frac{\left(\dfrac{W_{\mathrm{I}} + W_{10}}{2}\right) + \sum_{i=1}^{9} W_{\mathrm{i}}}{W_{\mathrm{I}}} \times 10$$

(MTD 30)

Reprography Unit, BIS, New Delhi, India

Indian Standard

METHOD FOR DETERMINATION OF CLUSTERING OF IRON OXIDE FEEDSTOCK FOR DIRECT REDUCTION PROCESSES

1 SCOPE

This standard prescribes the method for determination of clustering characteristics of iron ore lumps and pellets during reduction under conditions similar to those prevailing in direct reduction process carried out in a shaft furnace using gaseous reducing agent.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
460 (Part 2) : 1985	Test sieves : Part 2 Perforated plate test sieves (*third revision*)
1405 : 1982	Methods of sampling of iron ores (*second revision*)

3 TERMINOLOGY

For the purpose of this standard, the following definition shall apply:

Clustering—It is a measure of the inclination of the material tested to clustering into solid aggregates under the prevailing temperature, gas composition and the load condition of the test.

4 TEST SAMPLE

4.1 The sample shall be taken in accordance with the procedures specified in IS 1405. The test sample shall be oven dried at 105 ± 5°C and cooled to room temperature before the preparation of the proper test portion.

4.2 The sample weight shall be 1 000 g.

4.3 Lump ore size shall be 10 to 15 mm and pellet size shall be 10 to 12.5 mm for the purpose of test sample.

5 REDUCING GAS

Reducing gas composition shall be as follows:

H_2 = 55 percent ± 0.5 (*v/v*)
CO = 35 percent ± 0.5 percent (*v/v*)
CO_2 = 5 percent ± 0.5 percent (*v/v*)
H_2O = 5 percent ± 0.5 percent

6 APPARATUS

6.1 Gas Supply System

It shall be capable of supplying the gases at the specified gas flow rates, connected to the tube in such a manner that weighing shall not be affected.

6.2 Reduction Tube

It shall be made of non-scaling heat resisting metal capable of withstanding a temperature of 950°C. The inside diameter of the tube shall be 125 ± 1 mm.

6.3 Furnace

A suitable furnace capable of holding the test sample at the specified temperature having three separate sections to obtain a correct temperature profile. The temperature of the sample can be measured and monitored by means of thermocouples located above and below the bed.

6.4 Test Sieves

Test sieves conforming to relevant Part of IS 460 and having square aperture of nominal sizes 25.0 mm, 16.0 mm, 12.5 mm and 10.0 mm shall be used.

6.5 Weighing Balance

A suitable balance capable of weighing a load to a sensitivity of 1 g.

7 TEST PROCEDURE

The reduction tube that holds a die, a pneumatic cylinder and a 125 mm internal diameter cylinder containing a bed of sample is lowered into a electrically heated furnace. The cylinder containing the sample has a perforated bottom. The inner wall of the cylinder is lined with an incombustible fibre material to prevent sticking of the sample to the wall. The tube assembly is suspended from an electronic balance. The sample is loaded by means of the pneumatic cylinder and the die. In order to avoid sticking of sample to the bottom of the cylinder or to the die, the cylinder bottom and top of the sample all may be covered with a layer of alumina pellets.

The sample is dried to a constant weight at 105°C. The dried sample is then placed in the cylinder. The cylinder is lowered into the tube, followed by insertion of the remaining apparatus. The tube assembly is then lowered into the furnace and attached to the electronic balance. A stream of nitrogen is passed through the tube with simultaneous heating of the sample. As soon as the desired temperature of 950 ± 5°C is reached, nitrogen is replaced by the reducing gas. The gas flow rate shall be 83 l/min. The weight loss is recorded continuously till 95 percent reduction of the sample is achieved. On completion of reduction, the sample is loaded by the die for the stipulated time at the test temperature in a nitrogen atmosphere. The tube is then removed from the furnace and the sample is cooled in nitrogen. The clustered sample is removed from the cylinder and subjected to a drop test from a height of 100 cm. The procedure is repeated until either 100 g are still cemented together or for a maximum of 20 times. After each drop, the weight of the cluster is recorded. The percentage of clustered material remaining is plotted on a graph as a function of the number of drops. The curve is drawn. The shape of the curve gives the indication of degree of sticking. The following graph shall explain the method for finding out sticking index from the graph plotted.

The test reporting can be made as:

$$\text{Sticking Index} = \frac{\text{Area of ABCO}}{\text{Area of A}\acute{\text{A}}\text{CO}} \times 100$$

Sticking index can also be assessed by the following formula:

$$\text{Sticking Index} = \frac{\left[\dfrac{W_I + W_{10}}{2}\right] + \sum_{i=1}^{9} = W_i \times 10}{W_I}$$

W_I = weight in grams of the reduced material before the drop,

W_{10} = weight in grams of the clustered material if it remains after tenth drop, and

W_i = weight in grams of the cluster of the i^{th} drop.

The shape of the curve is a direct indication of clustering tendency. The ratio of the area below the curve and the total area below the curve when there is no disintegration of the clustered material at each drop (up to 10 *Max*). The total area is obtained by extending the point on *Y*-axis (point graphed before Ist drop) parallel to *X*-axis up to 10 drops or to the minimum drops when clustered mess is less than 100 g. The ratio is multiplied by 100 for finding out the sticking index.

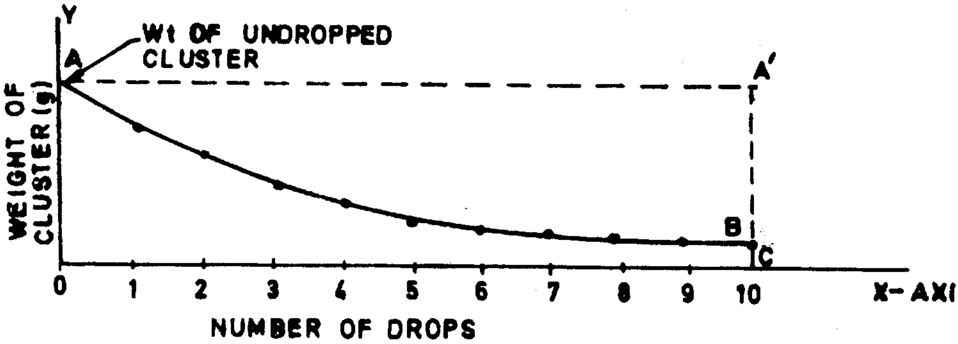

FIG. 1 METHOD OF FINDING OUT STICKING INDEX

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